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(54) **Axially compact fuel filter**

(57) A fuel filter, including: a housing, an inlet port, and an outlet port. The housing includes: a first axially disposed side wall forming a radially outermost portion of a circumference for the housing; a second axially disposed side wall located radially inward of the first axially disposed wall; a first radially disposed end wall connected to a first axial edge of the first axially disposed wall; and a second radially disposed end wall connected to a first axial edge of the second axially disposed side wall. The outlet port extends from the second radially disposed end wall and is radially aligned with the second axially disposed side wall. The inlet port extends from the first radially disposed end wall.

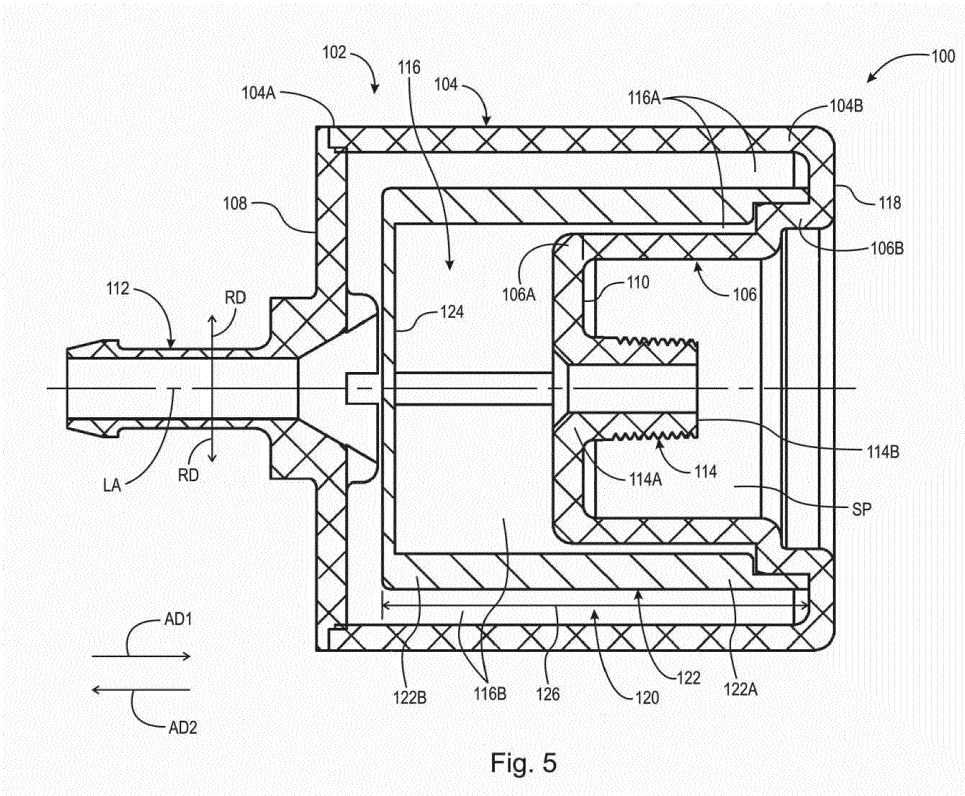

Fig. 5

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Description

[0001] The present disclosure relates to an axially compact fuel filter, in particular a fuel filter with a recess outlet port.

[0002] Figure 7 is a schematic cross-sectional view of typical prior art fuel filter **200.** Filter **200** includes housing **202,** cavity **204** formed by the housing, filter element **206** located in the cavity, inlet port **208,** and outlet port **210.** Fuel filters are used in a wide variety of combustion engine applications. In general, it is desirable to minimize axial length **212** of filter **200** while attaining a desired filtering capacity or function. The filtering capacity or function is dependent upon length **216** of element **206,** which in turn is dependent upon axial length **214,** which along with the respective positions of the input and output ports determines overall axial length **212.**

[0003] According to aspects illustrated herein, there is provided a fuel filter, including: a housing, an inlet port, and an outlet port. The housing includes: a first axially disposed side wall forming a radially outermost portion of a circumference for the housing; a second axially disposed side wall located radially inward of the first axially disposed wall; a first radially disposed end wall connected to a first axial edge of the first axially disposed wall; and a second radially disposed end wall connected to a first axial edge of the second axially disposed side wall. The outlet port extends from the second radially disposed end wall and is radially aligned with the second axially disposed side wall. The inlet port extends from the first radially disposed end wall.

[0004] According to aspects illustrated herein, there is provided a fuel filter, including: a housing including a first axially disposed side wall forming a radially outermost portion of a circumference for the housing and a second axially disposed side wall located radially inward of the first axially disposed wall; a cavity enclosed by the housing and including a first portion enclosed, in a radial direction, by only the first axially disposed side wall and a second portion radially disposed between the first and second axially disposed side walls; an inlet port open to the cavity; and an outlet port open to the first portion of the cavity and including a distal end radially aligned with the second portion of the cavity.

[0005] According to aspects illustrated herein, there is provided a fuel filter, including: a housing including a first and second axially disposed side walls, a first radially disposed end wall directly connected to a first axial end of the first axially disposed side wall, a second radially disposed end wall directly connected to a first axial end of the second axially disposed side wall, and a third radially disposed end wall directly connected to respective second axial ends of the first and second axially disposed side walls; a cavity including a first portion at least partially bounded by the first and third radially disposed end walls and the first axially disposed side wall and a second portion open to the first portion and at least partially bounded by the first and second axially disposed side walls and the third radially disposed end wall; an outlet port open to the first portion of the cavity, and including a first end direction connected to the third radially disposed wall and a distal end radially aligned with the second portion of the cavity and with the first and second axially disposed side walls and separated from the second axially disposed wall, in a radial direction, by a space; an inlet port open to the first portion of the cavity and directly connected to the first radially disposed end wall; and a filter element including an axially extending portion including a first axial end sealed against the second axially disposed wall or the third radially disposed end wall and a radially extending portion directly connected to a second axial end of the axially extending portion and wholly disposed in the first portion of the cavity.

[0006] Various embodiments are disclosed, by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, in which:

Figure 1A is a perspective view of a cylindrical coordinate system demonstrating spatial terminology used in the present application;

Figure 1B is a perspective view of an object in the cylindrical coordinate system of Figure 1A demonstrating spatial terminology used in the present application; and,

Figure 2 is a side view of a fuel filter;

Figure 3 is an inlet end view of the fuel filter of Figure 2;

Figure 4 is an outlet end view of the fuel filter of Figure 2;

Figure 5 is a cross-sectional view generally along line 5,6-5,6 in Figure 4;

Figure 6 is a cross-sectional view generally along line 5,6-5,6 in Figure 4; and,

Figure 7 is a schematic representation of a typical prior art fuel filter.

[0007] At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical, or functionally similar, structural elements of the disclosure. It is to be understood that the disclosure as claimed is not limited to the disclosed aspects.

[0008] Furthermore, it is understood that this disclosure is not limited to the particular methodology, materials and modifications described and as such may, of course, vary. It is also understood that the terminology used herein is for the purpose of describing particular aspects only, and is not intended to limit the scope of the present disclosure.

[0009] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which this disclosure belongs. It should be understood that any methods, devices or materials similar or equivalent to those described herein can be used in the practice or testing of the disclosure.

[0010] Figure **1A** is a perspective view of cylindrical coordinate system **80** demonstrating spatial terminology used in the present application. The present invention is at least partially described within the context of a cylindrical coordinate system. System **80** has a longitudinal axis **81,** used as the reference for the directional and spatial terms that follow. The adjectives "axial," "radial," and "circumferential" are with respect to an orientation parallel to axis **81,** radius **82** (which is orthogonal to axis **81**), and circumference **83,** respectively. The adjectives "axial," "radial" and "circumferential" also are regarding orientation parallel to respective planes. To clarify the disposition of the various planes, objects **84, 85,** and **86** are used. Surface **87** of object **84** forms an axial plane. That is, axis **81** forms a line along the surface. Surface **88** of object **85** forms a radial plane. That is, radius **82** forms a line along the surface. Surface **89** of object **86** forms a circumferential plane. That is, circumference **83** forms a line along the surface. As a further example, axial movement or disposition is parallel to axis **81,** radial movement or disposition is parallel to radius **82,** and circumferential movement or disposition is parallel to circumference **83.** Rotation is with respect to axis **81.**

[0011] The adverbs "axially," "radially," and "circumferentially" are with respect to an orientation parallel to axis **81,** radius **82,** or circumference **83,** respectively. The adverbs "axially," "radially," and "circumferentially" also are regarding orientation parallel to respective planes.

[0012] Figure **1B** is a perspective view of object **90** in cylindrical coordinate system **80** of Figure **1A** demonstrating spatial terminology used in the present application. Cylindrical object **90** is representative of a cylindrical object in a cylindrical coordinate system and is not intended to limit the present invention in any manner. Object **90** includes axial surface **91,** radial surface **92,** and circumferential surface **93.** Surface **91** is part of an axial plane, surface **92** is part of a radial plane, and surface **93** is a circumferential surface.

[0013] Figure 2 is a side view of fuel filter **100.**

[0014] Figure 3 is an inlet end view of fuel filter **100** of Figure 2.

[0015] Figure 4 is an outlet end view of fuel filter **100** of Figure 2.

[0016] Figure 5 is a cross-sectional view generally along line 5,6-5,6 in Figure 4. The following should be viewed in light of Figures 2 through 5. Fuel filter **100** includes longitudinal axis **LA** and housing **102** including axially disposed side walls **104** and **106** and radially disposed end wall **108** and **110.** Side wall **104** forms a radially outermost portion of a circumference for the housing. Side wall **106** is located radially inward of side wall **104.** End wall **108** is connected to axial edge **104A** of side wall **104.** End wall **110** is connected to axial edge **106A** of side wall **106.** Filter **100** includes inlet port **112** and outlet port **114.** Port **112** extends from end wall **108.** Port **114** extends from end wall **110** and is radially aligned with side wall **106.** Note that radial and axial references are with respect to axis **LA**.

[0017] In an example embodiment, the outlet port includes axial end **114A** directly connected the end wall **110** and distal end **114B** radially aligned with side walls **104** and **106.** In an example embodiment, an entirety of the outlet port is radially aligned with side walls **104** and **106** and is separated, in radial direction **RD,** from side wall **106** by space **SP** external to housing **102.**

[0018] In an example embodiment, axial direction **AD1** is from the inlet port toward the outlet port and the outlet port includes axial end **114A** directly connected end wall **110,** and distal end. Each of side walls **104** and **106** extends past distal end **114B** in axial direction **AD1.**

[0019] Fuel filter **100** includes cavity **116** enclosed by the housing. In an example embodiment, axial direction **AD1** is from the inlet port toward the outlet port and the outlet port includes axial end **114A** directly connected end wall **110,** and distal end **114B.** Portion **116A** of the cavity extends past distal end **114B** axial direction **AD1.**

[0020] In an example embodiment, the housing includes radially disposed end wall **118** connecting axial end **104B,** opposite axial end **104A**, of side wall **104** to axial end **106B,** opposite the axial end **106A**, of side wall **106.** For axial direction **AD1** from the inlet port toward the outlet port, end wall **118** is located past distal end **114B** in axial direction **AD1.**

[0021] In an example embodiment, portion **116A** of the cavity is radially disposed between side walls **104** and **106.** Portion **116B** of the cavity is radially disposed between side wall **104** and is free of alignment, in radial direction **RD,** with side wall **106.**

[0022] In an example embodiment, fuel filter **100** includes filter element **120,** located within cavity **116,** and including axially disposed wall **122** and radially disposed wall **124** connected to axially disposed wall **122.** Wall **124** is located only in portion **116B.** At least a portion of wall **122** is radially aligned with the outlet port. In an example embodiment, portion **122A** of wall **122** is radially disposed between side walls **104** and **106** and portion **122B** of axially disposed wall **122** is radially aligned with side wall **104** and free of alignment, in radial direction **RD,** with side wall **106.**

[0023] Figure 6 is a cross-sectional view generally along line 5,6-5,6 in Figure 4. The following should be viewed in light of Figures 2 through 6. Figure 6 is used to illustrate aspects of cavity **116.** In an example embodiment, portion **116B** of cavity **116** is at least partially bounded by end wall **108** in axial direction **AD2**, opposite direction **AD1** and end wall **110** in direction **AD1.** In an example embodiment, portion **122A** divides portion **116A** of cavity **116** into portions **116C** and **116D** and portion **122B** divides portion **116B** of cavity **116** into portions **116E** and **116F.** In an example embodiment, portion **116C** opens to portion **116E** and portion **116D** opens to portion **116F.**

[0024] In an example embodiment, portion **116G** of cavity **116** is axially located end wall **108** and wall **124** of the filter element **120.** In an example embodiment, end **122C** of filter wall **122** is sealed against wall **106** and/or

wall **118** to ensure that fluid entering cavity **116** from the inlet port **112** passes through and not around filter **120.** In an example embodiment, wall **106** includes stepped portion **106C** and end **122C** is sealed against the stepped portion and/or end wall **118.** Typical fluid flow paths **FP** are shown in Figure 6.

[0025] In an example embodiment, end wall **108** is formed as a separate end cap including inlet port **112,** and walls **104, 106,** and **110** are part of an integral unit including outlet port **114.**

[0026] The capacity or function of fuel filter **100** is at least partly dependent upon how much filter material is available for filter, which is at least partly dependent upon length **126** of element **120,** which in turn is dependent upon axial length **128** of the housing. As discussed above, it is desirable to attain a specified filter capacity or function while minimizing overall axial length **120** of filter **100.** Advantageously, by recessing outlet port **114** into space **SP,** filter **100** maximizes lengths **126** and length **128,** while minimizing overall length **130** of filter **100.** Specifically, outlet port **114** does not contribute to length **130.** For example, lengths **126** and **128** can be made equal to lengths **216** and **214** noted above, with length **130** being advantageously less than length **212.** Thus, the same or greater fuel filter capacity is enabled for filter **100** while minimizing overall axial length **130** of filter **100.**

[0027] According to a embodiment of the invention the fuel filter **100,** comprises a housing **102** with a first axially disposed side wall **104,** forming a radially outermost portion of a circumference for the housing **102** and a second axially disposed side wall **106** located radially inward of the first axially disposed wall **104.** A cavity **116** is enclosed by the housing **102.** The cavity **116** has a first portion **116A** enclosed, in a radial direction **RD,** by only the first axially disposed side wall **104.** A second portion **116B** is radially disposed between the first and second axially disposed side walls **104, 106.** An inlet port **112** is open to the cavity **116.** An outlet port **114** is open to the first portion **116A** of the cavity **116** and including a distal end **114A** radially aligned with the second portion **116A** of the cavity **116.**

[0028] The housing **102** includes a first radially disposed end wall **108** directly connected to an axial edge **104A** of the first axially disposed side wall **104** and the inlet port **112.** A second radially disposed end wall **110** directly connected to an axial edge **106A** of the second axially disposed side wall **106.** The radially disposed end wall **110** has an outlet port **114.** The first portion **116A** of the cavity **116** is at least partially bounded by the first radially disposed end wall **108** in a first axial direction **AD1** and the second radially disposed end wall **110** in a second axial direction **AD2** which is opposite the first axial direction **AD1.** Furthermore, the housing **102** includes a radially disposed end wall **118** directly connected to respective axial edges **104B, 106B** of the first and second axially disposed side walls **104, 106.** The second portion 116B of the cavity 116 is open to the first portion **116A** of the cavity **116** and is at least partially bounded by the radially disposed end wall **118.**

[0029] A filter element **120** of the fuel filter **100** includes an axially disposed wall **122** located in the first and second portions **116A**, **116B** of the cavity **116.** A radially disposed wall **124** is directly connected to the axially disposed wall **122** and located only in the first portion **116A** of the cavity **116.** A first portion **122A** of the axially disposed wall **122** for the filter element **120** divides the second portion **116B** of the cavity **116** into third and fourth portions **116C, 116D.** A second portion **122B** of the axially disposed wall **122** for the filter element **120** divides a part of the first portion **116A** of the cavity **116** into fifth and sixth portions **116E, 116F.** The third portion **116C** is open to the fifth portion **116E** and the fourth portion **116D** is open to the sixth portion **116E.**

[0030] The housing **102** includes the radially disposed end wall **108** which is directly connected to the first axially disposed side wall **104** and the inlet port **112.** The radially disposed wall **124** of the filter element **120** bounds the fifth portion **116E** in an axial direction **AD1.** A seventh portion **116G** of the cavity **116** is axially located between the radially disposed end wall **108** and the radially disposed wall **124** of the filter element **120.** The outlet port **114** includes a distal end **114B** axially opposite the first end **114A** and distal end **114B** is aligned, in a radial direction **RD,** with the third **116C** and fourth portions **116D** of the cavity **116.** An inlet port **112** open to the first portion **116A** of the cavity **116** and extending from the first radially disposed end wall **118** in an axial direction **AD1.**

[0031] According to a further embodiment a fuel filter **100** has a housing **102** including a first and second axially disposed side walls **104, 106,** a first radially disposed end wall **108** directly connected to a first axial end **104A** of the first axially disposed side wall **104,** a second radially disposed end wall **110** directly connected to a first axial end **106A** of the second axially disposed side wall **106** and a third radially disposed end wall **118** directly connected to respective second axial ends **104B, 106B** of the first and second axially disposed side walls **104,106.** A cavity **116** includes a first portion **116A** at least partially bounded by the first and third radially disposed end walls **108, 118** and the first axially disposed side wall **104.** A second portion **116B** of the cavity **116** open to the first portion **116A** and at least partially bounded by the first and second axially disposed side walls **104, 106** and the third radially disposed end wall **118.** An outlet port **114** is open to the first portion **116A** of the cavity **116.** The outlet port **114** has a first end direction connected to the third radially disposed wall **118** and a distal end **114B** which is radially aligned with the second portion **116B** of the cavity **116** and with the first and second axially disposed side walls **104, 106.** The outlet port **114** is separated from the second axially disposed wall **106,** in a radial direction, by a space **SP.** An inlet port **112** is open to the first portion **116A** of the cavity **116** and directly connected to the first radially disposed end wall **108.** A filter element **120,** located within the cavity **116,**

encompasses an axially extending portion with a first axial end **122A** sealed against the second axially disposed wall **106** or the third radially disposed end wall **118** and a radially extending portion is directly connected to a second axial end **122B** of the axially extending portion and wholly disposed in the first portion **116A** of the cavity **116.**

[0032] It will be appreciated that various of the above-disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems or applications. Various presently unforeseen or unanticipated alternatives, modifications, variations, or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

Claims

1. A fuel filter (100), comprising:

a housing (102) including:

a first axially disposed side wall (104) forming a radially outermost portion of a circumference for the housing (102);
a second axially disposed side wall (106) located radially inward of the first axially disposed wall (104);
a first radially disposed end wall (108) connected to a first axial edge (104A) of the first axially disposed wall (104); and,
a second radially disposed end wall (110) connected to a first axial edge (106A) of the second axially disposed side wall (106);

an outlet port (114) which extends from the second radially disposed end wall (110), and is radially aligned with the second axially disposed side wall (106); and,
an inlet port (112) extending from the first radially disposed end wall (108).

2. The fuel filter (100) of claim 1, wherein the radially disposed end wall (108) is directly connected to the first axially disposed side wall (104) and the inlet port (112).

3. The fuel filter (100) of claim 1 to 2, wherein the outlet port (114) includes:

a first axial end (114A) directly connected to the second radially disposed end wall (110); and,
a distal end (114B) radially aligned with the first and second axially disposed side walls (104, 106).

4. The fuel filter (100) of claim 1 to 3, wherein the outlet port (114) is separated, in a radial direction (RD), from the first axially disposed side wall (104) by a space (SP) external to the housing (102).

5. The fuel filter (100) of claim 1 to 4, wherein a cavity (116) enclosed by the housing (100) and an axial direction (AD1) is from the inlet port (112) toward the outlet port (114); the outlet port (114) includes a first axial end (114A) directly connected to the second axial end wall (110); a distal end (114B) radially aligned with the first and second axially disposed side walls (104, 106); and a portion of the cavity extends past the distal end (114B) in the axial direction (AD1).

6. The fuel filter (100) of claim 1 to 5, wherein a third radially disposed end wall (118) connects a second axial end (106B), opposite the first axial end (104B), of the first axially disposed side wall (104) to a second axial end, opposite the first axial end, of the second axially disposed side wall (106), an axial direction (AD1) is from the inlet port (112) toward the outlet port (114); and the third axial wall (122) is located past the distal end (114b) in the axial direction (AD1).

7. The fuel filter (100) of claims 5 to 6, wherein the cavity (116) enclosed by the housing 102, encompasses a first portion (116A) of the cavity (116) which is radially disposed between the first and second axially disposed side walls (104, 106); and a second portion (116B) of the cavity (116) which is radially disposed between the first axially disposed side wall (104, 106) and free of alignment, in a radial direction (RD), with the second axially disposed side wall (106).

8. The fuel filter (100) of claims 5 to 7, wherein a filter element (120) is located within the cavity (116), which includes an axially disposed wall (122) and a radially disposed wall (124) connected to the axially disposed wall (122) and radially aligned with the outlet port (114).

9. The fuel filter (100) of claim 8, wherein:

a first portion (122A) of the axially disposed wall (122) for the filter element (120) is radially disposed between the first and second axially disposed side walls (104, 106); and,
a second portion (122B) of the axially disposed wall (124) for the filter element (120) is:

radially aligned with the first axially disposed side wall (104); and,
free of alignment, in a radial direction (RD), with the second axially disposed side wall (106).

10. The fuel filter (100) of claim 8 to 9, wherein the inlet port (112) is open to the cavity (116) and the outlet

port (114) is open to the first portion (116A) of the cavity (116) and including a distal end (114B) are radially aligned with the second portion (116B) of the cavity (116)

11. The fuel filter (100) of claim 10, wherein the first portion (122A) of the axially disposed wall (122) for the filter element (120) divides the first portion (116A) of the cavity (116) into third and fourth portions (116C, 116D) and the second portion (112B) of the axially disposed wall (122) for the filter element (120) divides a part of the second (112B) portion of the cavity (116) into fifth and sixth portions (116E, 116F).

12. The fuel filter (100) of claim 11, wherein the third portion (116C) is open to the fifth portion (116E) the fourth portion (116D) is open to the sixth portion (116F).

13. The fuel filter (100) of claim 12, wherein the radially disposed wall (122) of the filter element (120) bounds the fifth portion (116 E) in an axial direction (AD1), and a seventh portion (116G) of the cavity (116) is axially located between the radially disposed end wall (124) and the radially disposed wall (108) of the filter element (120).

14. The fuel filter (100) of claim 11, wherein the outlet port (114) includes a distal end (114B) axially opposite the first end (114A) and the distal end (114B) is aligned, in a radial direction (RD), with the third and fourth portions (116C, 116D) of the cavity (116).

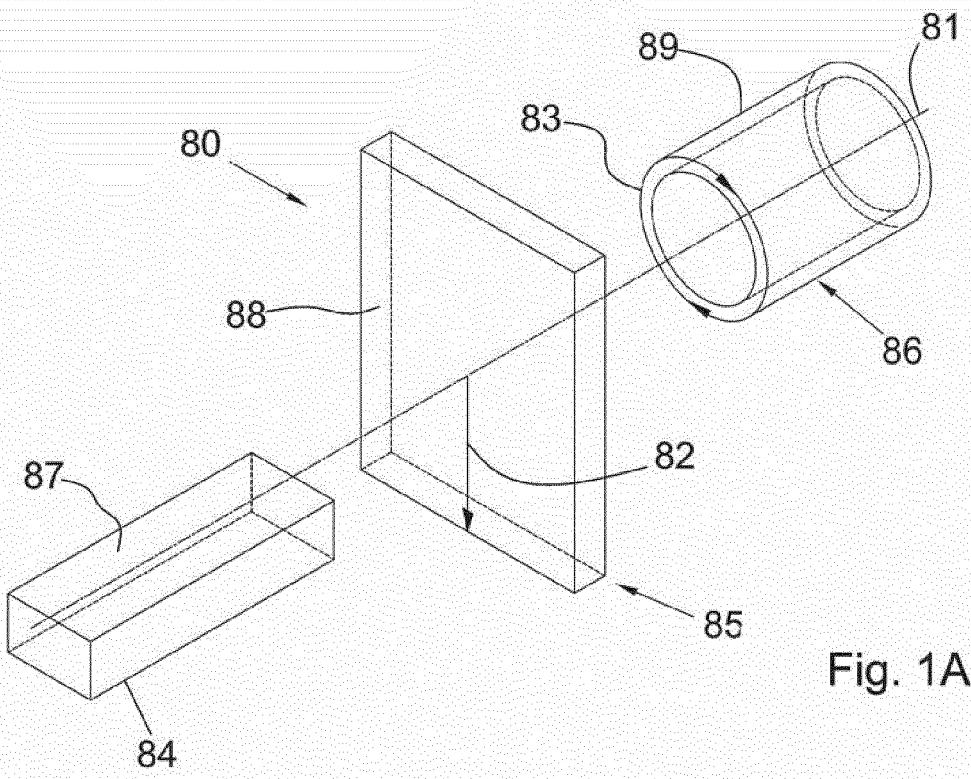


Fig. 1A

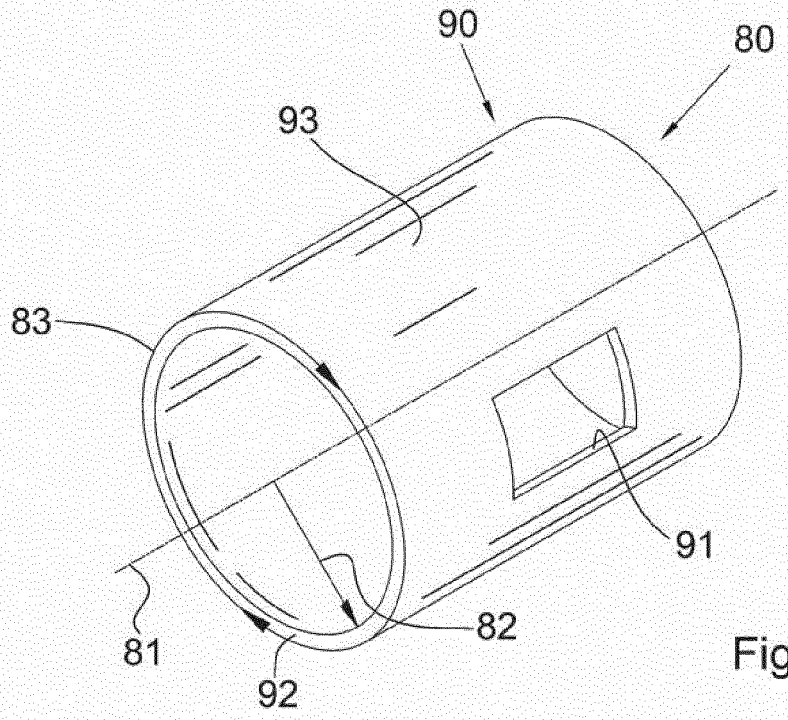


Fig. 1B

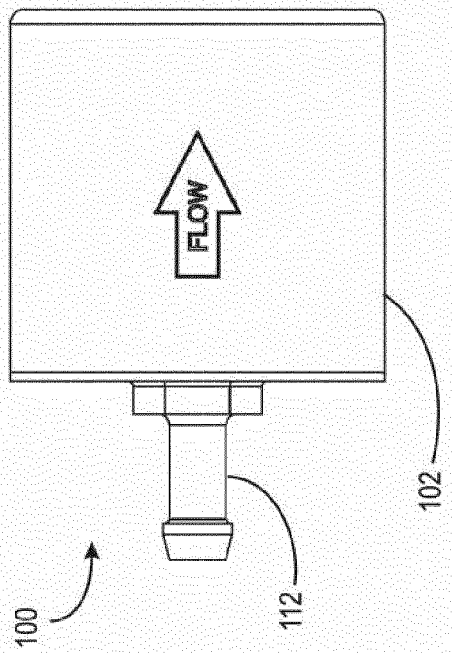


Fig. 2

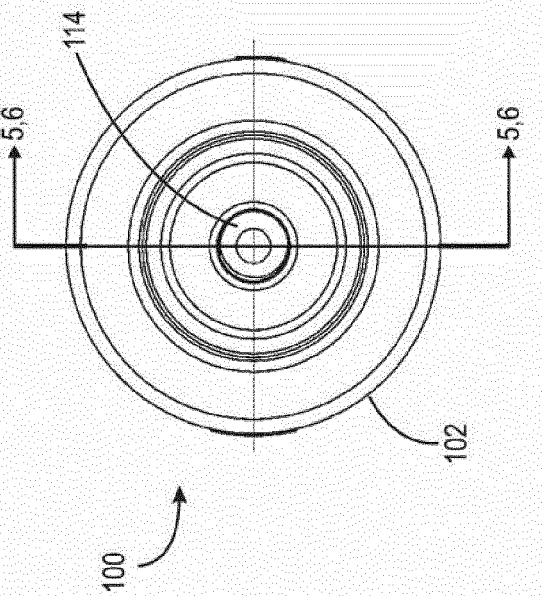


Fig. 4

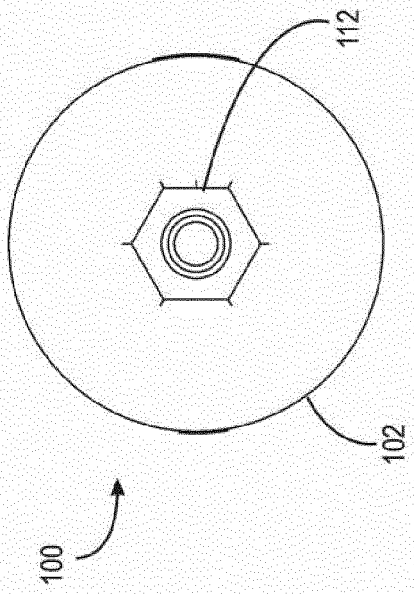
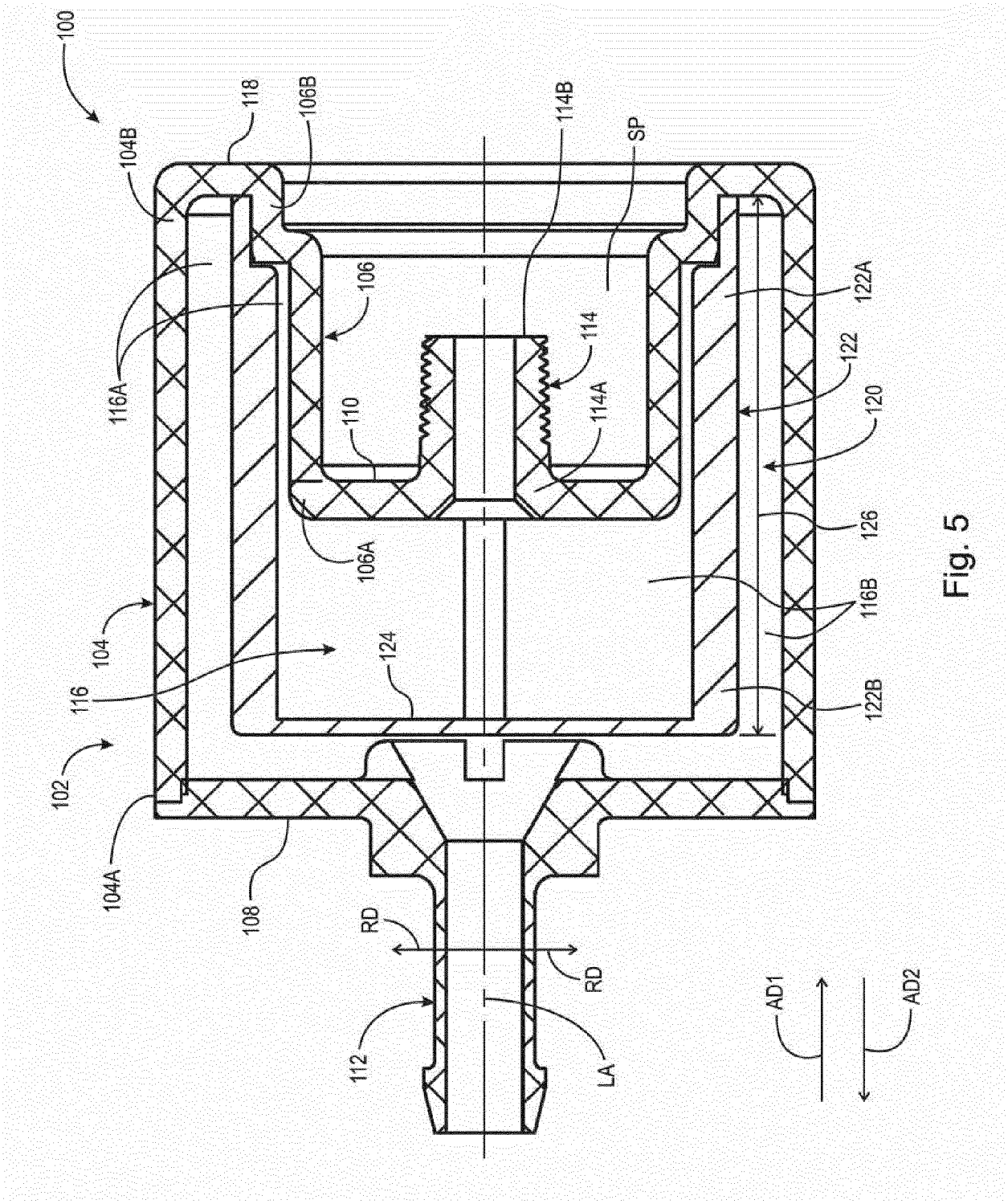


Fig. 3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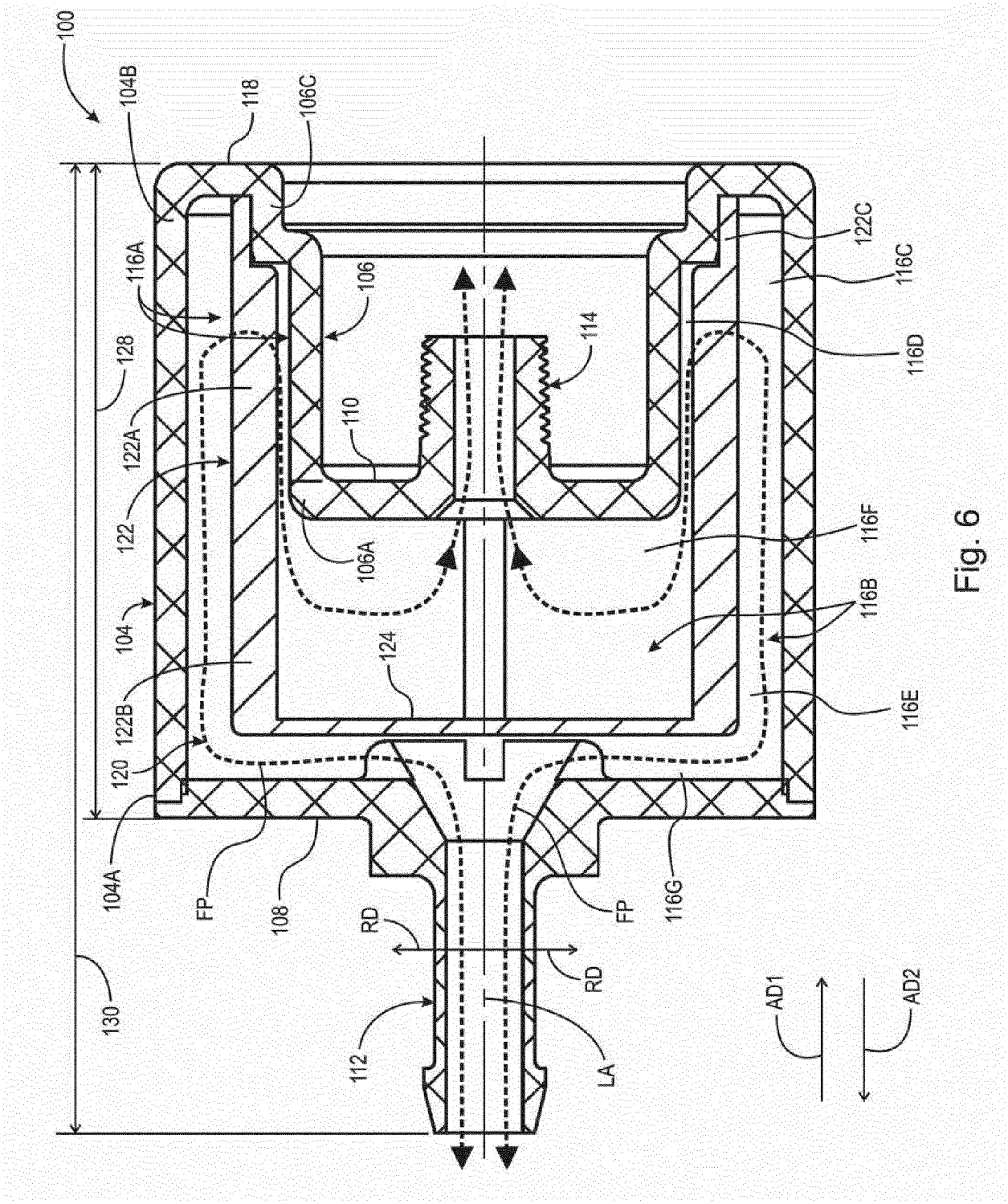
AD1
AD2

Fig. 5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AD1
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Fig. 6

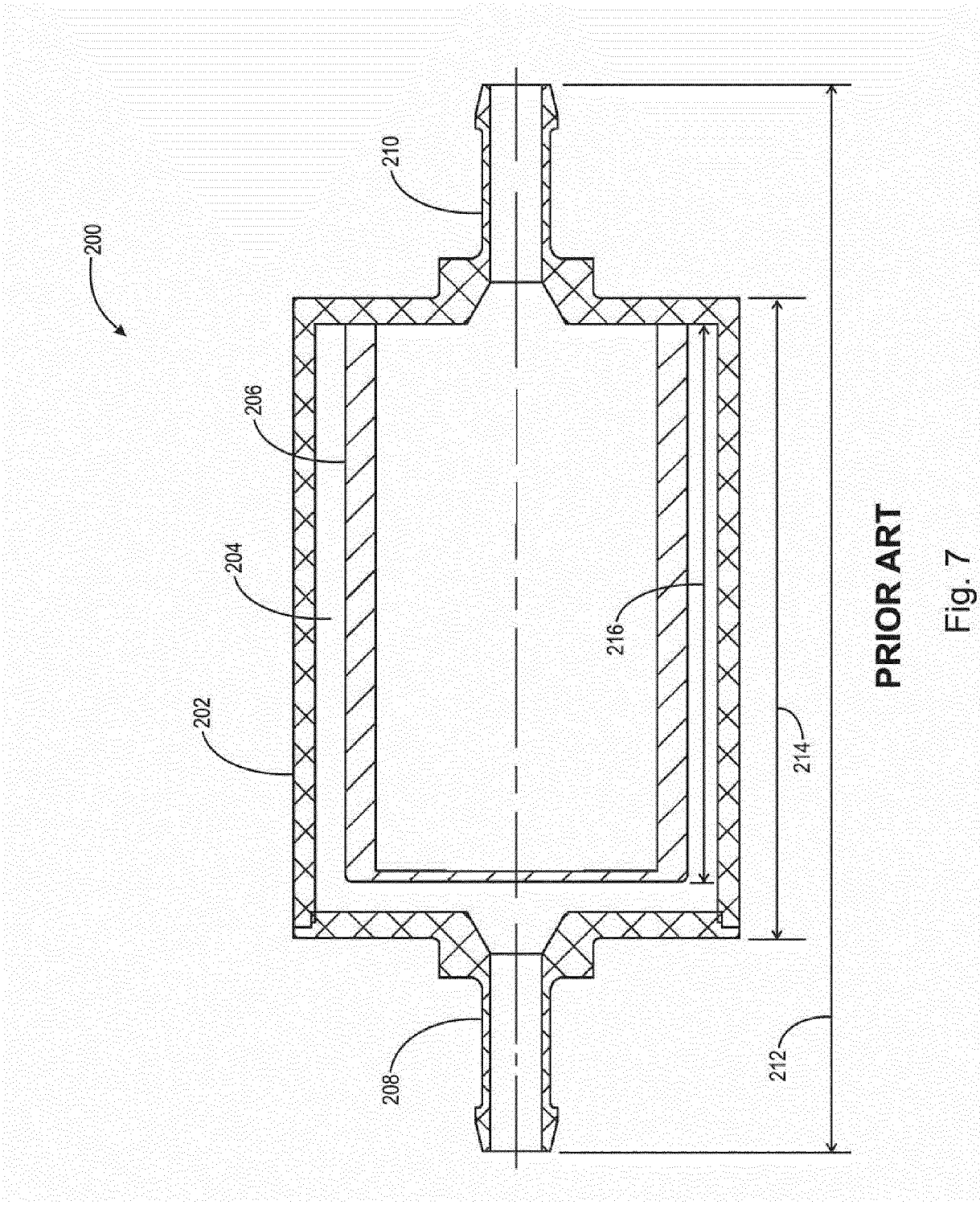

Fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 14 19 3928

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 595 371 B1 (DESMARAIS CHRIS [US]) 22 July 2003 (2003-07-22) * figure 2 *	1-14	INV. B01D35/30 B01D29/15 B01D35/00
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